

WHAT IS CLAIMED:

1. A method for measuring the conductivity (σ) of a liquid or paste electrophotographic toner comprising:

- 5 providing two parallel plane conductive plates with a uniform separation (d) between the plates to form a space between the plates;
filling the space between the plates with liquid or paste electrophotographic toner;
applying a voltage of at least 1V between the plates across the liquid or
10 paste toner;
measuring as data the current vs. time passing through the plates;
digitizing the data;
sending digitizing data to a processor; and
determining the conductivity from the digitized data.

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2. The method of claim 1 wherein determining conductivity and charge per mass from the digitized data includes determining toner particle current according to the relationships:

$$i = i_1 + i_2$$

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where $i_1 = af'(t)$

and $i_2 = i_0 \exp(-t/\tau_2)$

$$q = af(t)$$

$$i_1 = af'(t)$$

$$a^2 = 2\epsilon\zeta A^2 V_0$$

$$\tau = (R + R_2)(2\epsilon\zeta A^2)$$

$$f(t) = (e^{2at/\tau} - 1) / (e^{2at/\tau} + 1)$$

$$f'(t) = (a/\tau)(1 - f^2(t))$$

$$R = d / \sigma A,$$

$$i_2 = i_0 \exp(-t/\tau_2)$$

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Q/M (charge per mass) = $\zeta/\rho\alpha$, where ρ is the toner paste density and α is the paste concentration;

Wherein the terms in the Formulae affected are defined as	Symbol or letter	Meaning
$Q=af(t)$	q	Total toner charge accumulated on plate 6 at time t
	a	Square root of formula $a^2=2\epsilon\zeta A^2 V_0$ defined below
	f(t)	Function of time
$i_1=af'(t)$	i_1	Toner particle current
	a	Square root of formula $a^2=2\epsilon\zeta A^2 V_0$
	f'	Derivative of f, above
	t	Time
$a^2=2\epsilon\zeta A^2 V_0$	a^2	A parameter defined by solving the adjacent formula
	2ϵ	Two times the dielectric constant of the toner ink/paste
	ζ	Toner charge density
	A^2	The area of the plate, squared
	V_0	Applied voltage
$\tau=(R+R_2)(2\epsilon \zeta A^2)$	τ	A parameter defined by solving the formula
	R	Derived from $R=d/\sigma A$, defined below
	R_2	Resistance of resistor R_2 ,
	2ϵ	Two times the dielectric constant of the toner
	ζ	Toner charge density
	A^2	The area of the plate, squared
$R=d/\sigma A$	R	A parameter defined by solving the adjacent formula
	d	Separation between plates/distance

	σ	Conductivity of the ink/paste
	A	Area of the plate
$f(t)=e^{2at/\tau}-1)/(e^{2at/\tau}+1)$	$f(t)$	Definition of the function of time
	e	Natural logarithm
	$2at/\tau$	Solve using symbols defined above
$f'(t)=a/\tau(1-f^2(t))$	As defined above	
$i_2= i_0\exp(-t/\tau_2)$	i_0	The initial impurity current
	τ_2	The impurity migration time constant

3. The method of claim 1 wherein the voltage is between 50V and 1000V.

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4. The method of claim 1 including calculating the charge to mass ratio of the toner (Q/m) from ζ by assuming that the percent solids of the toner particles collected on the ground plate is the same as that collected on a development roller under a similar electroplating condition, wherein ζ is the associated charge density.

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5. The method of claim 2 including calculating the charge to mass ratio of the toner (Q/m) from ζ by assuming that the percent solids of the toner particles collected on the ground plate is the same as that collected on a development roller under a similar electroplating condition, wherein ζ is the associated charge density.

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6. The method of claim 3 including calculating the charge to mass ratio of the toner (Q/m) from ζ by assuming that the percent solids of the toner particles collected on the ground plate is the same as that collected on a development roller under a similar electroplating condition, wherein ζ is the associated charge density.

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7. A method for measuring the conductivity (σ) of a liquid or paste electrophotographic toner comprising:

providing two parallel plane conductive plates with a uniform separation
(d) between the plates to form a space between the plates;

filling the space between the plates with liquid or paste
electrophotographic toner;

5 applying a current voltage of at least 1V between the plates across the
liquid or paste toner;

measuring as data the current passing through an external component into
the plates;

adjusting the data to remove current contributions attributable to impurity
10 ions;

sending adjusted data to a processor; and

determining the conductivity from the adjusted data.

8. The method of claim 7 wherein the voltage is between 1V and 1000V.

15 9. The method of claim 7 including calculating the charge to mass ratio of the toner
(Q/m) from ζ by assuming that the percent solids of the toner particles collected on the
ground plate is the same as that collected on a development roller under a similar
electroplating condition, wherein ζ is the associated charge density.

20 10. The method of claim 8 including calculating the charge to mass ratio of the toner
(Q/m) from ζ by assuming that the percent solids of the toner particles collected on the
ground plate is the same as that collected on a development roller under a similar
electroplating condition, wherein ζ is the associated charge density.

25 11. An apparatus for measuring the conductivity of a liquid or paste toner comprising:
two parallel conductive plates (4, 6), an electrical switch (10) between the
plates, a power supply (12) between the electrical switch(10) and one of the two
conductive plates, a current sensor for measuring data relating to current (14), filter (16),
30 a digitizer (18), data storage and processor (20) having analytic capability for adjusting

the data relating to current to remove contributions to the data attributable to impurity ions.

12. The apparatus of claim 11 wherein a data digitizer (18) is present between the sensor
5 and the data storage and processor having analytic capability (20).

13. The apparatus of claim 11 wherein the switch is a high speed switch.

14. The apparatus of claim 11 wherein the switch is a bounceless switch.

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15. The method of claim 7 wherein the voltage is between 50V and 1000V.

16. The method of claim 7 wherein the voltage is between 100V and 1000V.

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